CLAIMS:

What is claimed is:

1. A method for a first peer and a second peer to maintain an optimized balance of a plurality of data transfers to one or more storage devices, where said method comprises the steps of:

(303) calculating a number of transfers, N(L), for each of said one or more storage devices;

(304) calculating a first average latency, AL1(L), for each of said one or more storage devices for said first peer;

(305) calculating a second average latency, AL2(L), for each of said one or more storage devices for said second peer;

(307) calculating an absolute value of the difference of said first average latency and said second average latency for each of said one or more storage devices;

(315) assigning as equal latency storage devices those of said one or more storage devices that have said absolute value less than or equal to a latency threshold;

(325) assigning those of said one or more storage devices to said first peer that have said second average latency more than the sum of said first average latency and said latency threshold;

(330) assigning those of said one or more storage devices to said second peer that have said first average latency more than the sum of said second average latency and said latency threshold;

(340) calculating a first peer latency, T1, for said those of said one or more storage devices assigned to said first peer;

(343) calculating a second peer latency, T2, for said those of said one or more storage devices assigned to said second peer;

(345) calculating a equal latency, Teq, for said those of said one or more storage devices assigned as equal latency storage devices;

(350) calculating a latency difference, Td, between said first peer latency, T1, and said second peer latency, T2, and calculating an absolute value of said latency difference, Td;

(355) in response to said absolute value of said latency difference being greater than said equal latency, Teq, reassigning said those of said one or more storage devices assigned to said first peer and said those of said one or more storage devices assigned to said second peer to said first peer and said second peer so that said absolute value of said latency difference when recalculated with said reassignment of said those of said one or more storage devices assigned to said first peer and said those of said one or more storage devices assigned to said second peer to said first peer and said second peer is less than or equal to said equal latency, Teq;

(357) reassigning said those of said one or more storage devices assigned as equal latency storage devices to said first peer and said second peer to minimize said absolute value of said latency difference, Td; and

(360) transferring all data from said first peer to said one or more storage devices assigned to said first peer and transferring all data from said second peer to said one or more storage devices assigned to said second peer.

2. The method of claim 1, wherein step 357 further comprises:

in response to said second peer latency, T2, being greater than or equal to said first peer latency, T1 performing the following steps:

(420) calculating a first equal latency, Tne1, where Tne1 = (T2 - T1 + Teq) /2;

(425) selecting one of said one or more storage devices assigned as equal latency storage devices and obtaining an identification number I for said selected storage device;

(430) calculating a number of first equal transfers, Nne1(I), for said selected storage device identified by said identification number I, where Nne1(I) = Tne1 / AL1(I);

(440) in response to said number of first equal transfers Nne1(I) being more than said number of transfers N(I) for said selected storage device identified by said

identification number I, reassign said selected storage device identified by said identification number, I, to said first peer, recalculate first equal latency, Tne1, to remove the latency of said selected storage device identified by said identification number, I, and return to step 425;

(445) in response to said number of first equal transfers Nne1(I) being less than or equal to said number of transfers N(I) for said selected storage device identified by said identification number I, reassign said number of first equal transfers Nne1(I) to said selected storage device identified by said identification number, I, to said first peer; and

(447) reassign to said second peer those of said one or more storage devices assigned as equal latency storage devices not assigned to said first peer.

3. The method of claim 2, wherein step 425 further comprises:

selecting one of said one or more storage devices assigned as equal latency storage devices that has the largest first average latency, AL1(I), and obtaining an identification number, I, for said selected storage device.

4. The method of claim 1, wherein step 357 further comprises:

in response to said first peer latency, T1 being greater than said second peer latency, T2, performing the following steps:

(421) calculating a second equal latency, Tne2, where Tne2 = (T1 - T2 + Teq) /2;

(426) selecting one of said one or more storage devices assigned as equal latency storage devices and obtaining an identification number, I, for said selected storage device;

(431) calculating a number of second equal transfers, Nne2(I), for said selected storage device identified by said identification number, I, where Nne2(I) = Tne2 /AL2(I);

(441) in response to said number second equal transfers, Nne2(I), being more than said number of transfers, N(I), for said selected storage device identified by said identification number I, reassign said selected storage device identified by said

identification number I to said second peer, recalculate Tne2, to remove the latency of said selected storage device identified by said identification number, I, and return to step 426;

(446) in response to said number of second equal transfers, Nne2(I), being less than or equal to said number of transfers, N(I), for said selected storage device identified by said identification number I, assign said number of second equal transfers, Nne2(I), of said selected storage device identified by said identification number, I, to said second peer; and

(448) reassign to said first peer those of said one or more storage devices assigned as equal latency storage devices not assigned to said second peer.

5. The method of claim 4, wherein step 426 further comprises:

selecting one of said one or more storage devices assigned as equal latency storage devices that has the largest second average latency, AL2(I), and obtaining an identification number, I, for said selected storage device.

6. The method of claim 1 wherein step 355 further comprises:

in response to said second peer latency, T2, being greater than said first peer latency, T1, performing the following steps:

(520) calculating a first latency ratio, R1(L), for each of said one or more storage devices assigned to said second peer, where R1(L) = AL1(L)/AL2(L);

(525) selecting one of said one or more storage devices assigned to said second peer that has the smallest of said first latency ratio, R1(L), and obtaining an identification number, K, for said selected storage device;

(530) calculating a number of second peer transfers, Nn2(K), for said selected storage device identified by said identification number, K, where Nn2(K) = (T2-Teq-T1)/((1+R1(K))*AL2(K));

(540) in response to said number of second peer transfers, Nn2(K), being greater than said number of transfers, N(K), for said selected storage device identified by said

identification number K, reassign said selected storage device identified by said identification number, K, to said first peer, recalculate said first peer latency, T1, for said those of said one or more storage devices assigned to said first peer, recalculate said second peer latency, T2, for said those of said one or more storage devices assigned to said second peer and return to step 525; and

(545) in response to said number of second peer transfers, Nn2(K), being less than or equal to said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said number of second peer transfers, Nn2(K), of said selected storage device identified by said identification number, K, to said first peer.

7. The method of claim 1, wherein step 355 further comprises:

in response to said second peer latency, T2, being less than said first peer latency, T1, performing the following steps:

(521) calculating a second latency ratio, R2(L), for each of said one or more storage devices assigned to said first peer, where R2(L) = AL2(L)/AL1(L);

(526) selecting one of said one or more storage devices assigned to said first peer that has the smallest of said latency ratio, R2(L), and obtaining an identification number K for said selected storage device;

(531) calculating a number of first peer transfers, Nn1(K), for said selected storage device identified by said identification number, K, where Nn1(K) = (T1-Teq-T2)/((1+R2(K))*AL1(K));

(541) in response to said number of first peer transfers, Nn1(K), being greater than said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said selected storage device identified by said identification number, K, to said second peer, recalculate said first peer latency, T1, for said those of said one or more storage devices assigned to said first peer, recalculate said second peer latency, T2, for said those of said one or more storage devices assigned to said second peer and return to step 526; and

(546) in response to said first peer transfer number, Nn1(K), being less than or equal to said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said number of first peer transfers Nn1(K) of said selected storage device identified by said identification number, K, to said second peer.

8. The method of claim 1 further comprising the additional steps of:

measuring a first amount of elapsed time for said transferring all data from said first peer to said one or more storage devices assigned to said first peer;

measuring a second amount of elapsed time for said transferring all data from said second peer to said one or more storage devices assigned to said second peer;

recalculating said first average latency, AL1(L), by use of said first amount of elapsed time with a moving weighted average calculation for each of said one or more storage devices assigned to said first peer; and

recalculating said second average latency, AL2(L), by use of said second amount of elapsed time with said moving weighted average calculation for each of said one or more storage devices assigned to said second peer.

9. An article of manufacture comprising a data storage medium tangibly embodying a program of machine-readable instructions executable by a digital processing apparatus to perform method steps for a first peer and a second peer to maintain an optimized balance of a plurality of data transfers to one or more storage devices, said method steps comprising:

(303) calculating a number of transfers, N(L), for each of said one or more storage devices;

(304) calculating a first average latency, AL1(L), for each of said one or more storage devices for said first peer;

(305) calculating a second average latency, AL2(L), for each of said one or more storage devices for said second peer;

(307) calculating an absolute value of the difference of said first average latency and said second average latency for each of said one or more storage devices;

(315) assigning as equal latency storage devices those of said one or more storage devices that have said absolute value less than or equal to a latency threshold;

(325) assigning those of said one or more storage devices to said first peer that have said second average latency more than the sum of said first average latency and said latency threshold;

(330) assigning those of said one or more storage devices to said second peer that have said first average latency more than the sum of said second average latency and said latency threshold;

(340) calculating a first peer latency, T1, for said those of said one or more storage devices assigned to said first peer;

(343) calculating a second peer latency, T2, for said those of said one or more storage devices assigned to said second peer;

(345) calculating a equal latency, Teq, for said those of said one or more storage devices assigned as equal latency storage devices;

(350) calculating a latency difference, Td, between said first peer latency, T1, and said second peer latency, T2, and calculating an absolute value of said latency difference, Td;

(355) in response to said absolute value of said latency difference being greater than said equal latency, Teq, reassigning said those of said one or more storage devices assigned to said first peer and said those of said one or more storage devices assigned to said second peer to said first peer and said second peer so that said absolute value of said latency difference when recalculated with said reassignment of said those of said one or more storage devices assigned to said first peer and said those of said one or more storage devices assigned to said second peer to said first peer and said second peer is less than or equal to said equal latency, Teq;

(357) reassigning said those of said one or more storage devices assigned as equal latency storage devices to said first peer and said second peer to minimize said absolute value of said latency difference, Td; and

(360) transferring all data from said first peer to said one or more storage devices assigned to said first peer and transferring all data from said second peer to said one or more storage devices assigned to said second peer.

10. The article of manufacture of claim 9, wherein step 357 further comprises:

in response to said second peer latency, T2, being greater than or equal to said first peer latency, T1 performing the following steps:

(420) calculating a first equal latency, Tne1, where Tne1 = (T2 - T1 + Teq) /2;

(425) selecting one of said one or more storage devices assigned as equal latency storage devices and obtaining an identification number I for said selected storage device;

(430) calculating a number of first equal transfers, Nne1(I), for said selected storage device identified by said identification number I, where Nne1(I) = Tne1 / AL1(I);

(440) in response to said number of first equal transfers Nne1(I) being more than said number of transfers N(I) for said selected storage device identified by said identification number I, reassign said selected storage device identified by said identification number, I, to said first peer, recalculate first equal latency, Tne1, to remove the latency of said selected storage device identified by said identification number, I, and return to step 425;

(445) in response to said number of first equal transfers Nne1(I) being less than or equal to said number of transfers N(I) for said selected storage device identified by said identification number I, reassign said number of first equal transfers Nne1(I) to said selected storage device identified by said identification number, I, to said first peer; and

(447) reassign to said second peer those of said one or more storage devices assigned as equal latency storage devices not assigned to said first peer.

11. The article of manufacture of claim 10, wherein step 425 further comprises:

selecting one of said one or more storage devices assigned as equal latency storage devices that has the largest first average latency, AL1(I), and obtaining an identification number, I, for said selected storage device.

12. The article of manufacture of claim 9, wherein step 357 further comprises:

in response to said first peer latency, T1 being greater than said second peer latency, T2, performing the following steps:

(421) calculating a second equal latency, Tne2, where Tne2 = (T1 - T2 + Teq) /2;

(426) selecting one of said one or more storage devices assigned as equal latency storage devices and obtaining an identification number, I, for said selected storage device;

(431) calculating a number of second equal transfers, Nne2(I), for said selected storage device identified by said identification number, I, where Nne2(I) = Tne2 /AL2(I);

(441) in response to said number second equal transfers, Nne2(I), being more than said number of transfers, N(I), for said selected storage device identified by said identification number I, reassign said selected storage device identified by said identification number I to said second peer, recalculate Tne2, to remove the latency of said selected storage device identified by said identification number, I, and return to step 426;

(446) in response to said number of second equal transfers, Nne2(I), being less than or equal to said number of transfers, N(I), for said selected storage device identified by said identification number I, assign said number of second equal transfers, Nne2(I), of said selected storage device identified by said identification number, I, to said second peer; and

(448) reassign to said first peer those of said one or more storage devices assigned as equal latency storage devices not assigned to said second peer.

13. The article of manufacture of claim 12, wherein step 426 further comprises:

selecting one of said one or more storage devices assigned as equal latency storage devices that has the largest second average latency, AL2(I), and obtaining an identification number, I, for said selected storage device.

14. The article of manufacture of claim 9, wherein step 355 further comprises:

in response to said second peer latency, T2, being greater than said first peer latency, T1, performing the following steps:

(520) calculating a first latency ratio, R1(L), for each of said one or more storage devices assigned to said second peer, where R1(L) = AL1(L)/AL2(L);

(525) selecting one of said one or more storage devices assigned to said second peer that has the smallest of said first latency ratio, R1(L), and obtaining an identification number, K, for said selected storage device;

(530) calculating a number of second peer transfers, Nn2(K), for said selected storage device identified by said identification number, K, where Nn2(K) = (T2-Teq-T1)/((1+R1(K))*AL2(K));

(540) in response to said number of second peer transfers, Nn2(K), being greater than said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said selected storage device identified by said identification number, K, to said first peer, recalculate said first peer latency, T1, for said those of said one or more storage devices assigned to said first peer, recalculate said second peer latency, T2, for said those of said one or more storage devices assigned to said second peer and return to step 525; and

(545) in response to said number of second peer transfers, Nn2(K), being less than or equal to said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said number of second peer transfers, Nn2(K), of said selected storage device identified by said identification number, K, to said first peer.

15. The article of manufacture of claim 9, wherein step 355 further comprises:

in response to said second peer latency, T2, being less than said first peer latency, T1, performing the following steps:

(521) calculating a second latency ratio, R2(L), for each of said one or more storage devices assigned to said first peer, where R2(L) = AL2(L)/AL1(L);

(526) selecting one of said one or more storage devices assigned to said first peer that has the smallest of said latency ratio, R2(L), and obtaining an identification number K for said selected storage device;

(531) calculating a number of first peer transfers, Nn1(K), for said selected storage device identified by said identification number, K, where Nn1(K) = (T1-Teq-T2)/((1+R2(K))*AL1(K));

(541) in response to said number of first peer transfers, Nn1(K), being greater than said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said selected storage device identified by said identification number, K, to said second peer, recalculate said first peer latency, T1, for said those of said one or more storage devices assigned to said first peer, recalculate said second peer latency, T2, for said those of said one or more storage devices assigned to said second peer and return to step 526; and

(546) in response to said first peer transfer number, Nn1(K), being less than or equal to said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said number of first peer transfers Nn1(K) of said selected storage device identified by said identification number, K, to said second peer.

16. The article of manufacture of claim 9, wherein the method steps further comprise the steps of:

measuring a first amount of elapsed time for said transferring all data from said first peer to said one or more storage devices assigned to said first peer;

measuring a second amount of elapsed time for said transferring all data from said second peer to said one or more storage devices assigned to said second peer;

recalculating said first average latency, AL1(L), by use of said first amount of elapsed time with a moving weighted average calculation for each of said one or more storage devices assigned to said first peer; and

recalculating said second average latency, AL2(L), by use of said second amount of elapsed time with said moving weighted average calculation for each of said one or more storage devices assigned to said second peer.

17. A data storage system comprising:

one or more storage devices;

a storage management device for providing access to said one or more storage devices;

a first peer for transferring data to said one or more storage devices;

a second peer for transferring data to said one or more storage devices, wherein said first peer and said second peer are programmed to perform method steps for said first peer and said second peer to maintain an optimized balance of a plurality of data transfers to said one or more storage devices, comprising the steps of:

(303) calculating a number of transfers, N(L), for each of said one or more storage devices;

(304) calculating a first average latency, AL1(L), for each of said one or more storage devices for said first peer;

(305) calculating a second average latency, AL2(L), for each of said one or more storage devices for said second peer;

(307) calculating an absolute value of the difference of said first average latency and said second average latency for each of said one or more storage devices;

(315) assigning as equal latency storage devices those of said one or more storage devices that have said absolute value less than or equal to a latency threshold;

(325) assigning those of said one or more storage devices to said first peer that have said second average latency more than the sum of said first average latency and said latency threshold;

(330) assigning those of said one or more storage devices to said second peer that have said first average latency more than the sum of said second average latency and said latency threshold;

(340) calculating a first peer latency, T1, for said those of said one or more storage devices assigned to said first peer;

(343) calculating a second peer latency, T2, for said those of said one or more storage devices assigned to said second peer;

(345) calculating a equal latency, Teq, for said those of said one or more storage devices assigned as equal latency storage devices;

(350) calculating a latency difference, Td, between said first peer latency, T1, and said second peer latency, T2, and calculating an absolute value of said latency difference, Td;

(355) in response to said absolute value of said latency difference being greater than said equal latency, Teq, reassigning said those of said one or more storage devices assigned to said first peer and said those of said one or more storage devices assigned to said second peer to said first peer and said second peer so that said absolute value of said latency difference when recalculated with said reassignment of said those of said one or more storage devices assigned to said first peer and said those of said one or more storage devices assigned to said second peer to said first peer and said second peer is less than or equal to said equal latency, Teq;

(357) reassigning said those of said one or more storage devices assigned as equal latency storage devices to said first peer and said second peer to minimize said absolute value of said latency difference, Td; and

(360) transferring all data from said first peer to said one or more storage devices assigned to said first peer and transferring all data from said second peer to said one or more storage devices assigned to said second peer.

18. The system of claim 17, wherein step 357 further comprises:

in response to said second peer latency, T2, being greater than or equal to said first peer latency, T1 performing the following steps:

(420) calculating a first equal latency, Tne1, where Tne1 = (T2 - T1 + Teq) /2;

(425) selecting one of said one or more storage devices assigned as equal latency storage devices and obtaining an identification number I for said selected storage device;

(430) calculating a number of first equal transfers, Nne1(I), for said selected storage device identified by said identification number I, where Nne1(I) = Tne1 / AL1(I);

(440) in response to said number of first equal transfers Nne1(I) being more than said number of transfers N(I) for said selected storage device identified by said identification number I, reassign said selected storage device identified by said identification number, I, to said first peer, recalculate first equal latency, Tne1, to remove the latency of said selected storage device identified by said identification number, I, and return to step 425;

(445) in response to said number of first equal transfers Nne1(I) being less than or equal to said number of transfers N(I) for said selected storage device identified by said identification number I, reassign said number of first equal transfers Nne1(I) to said selected storage device identified by said identification number, I, to said first peer; and

(447) reassign to said second peer those of said one or more storage devices assigned as equal latency storage devices not assigned to said first peer.

19. The system of claim 18, wherein step 425 further comprises:

selecting one of said one or more storage devices assigned as equal latency storage devices that has the largest first average latency, AL1(I), and obtaining an identification number, I, for said selected storage device.

20. The system of claim 17, wherein step 357 further comprises:

in response to said first peer latency, T1 being greater than said second peer latency, T2, performing the following steps:

(421) calculating a second equal latency, Tne2, where Tne2 = (T1 - T2 + Teq) /2;

(426) selecting one of said one or more storage devices assigned as equal latency storage devices and obtaining an identification number, I, for said selected storage device;

(431) calculating a number of second equal transfers, Nne2(I), for said selected storage device identified by said identification number, I, where Nne2(I) = Tne2 /AL2(I);

(441) in response to said number second equal transfers, Nne2(I), being more than said number of transfers, N(I), for said selected storage device identified by said identification number I, reassign said selected storage device identified by said identification number I to said second peer, recalculate Tne2, to remove the latency of said selected storage device identified by said identification number, I, and return to step 426;

(446) in response to said number of second equal transfers, Nne2(I), being less than or equal to said number of transfers, N(I), for said selected storage device identified by said identification number I, assign said number of second equal transfers, Nne2(I), of said selected storage device identified by said identification number, I, to said second peer; and

(448) reassign to said first peer those of said one or more storage devices assigned as equal latency storage devices not assigned to said second peer.

21. The system of claim 20, wherein step 426 further comprises:

selecting one of said one or more storage devices assigned as equal latency storage devices that has the largest second average latency, AL2(I), and obtaining an identification number, I, for said selected storage device.

22. The system of claim 17, wherein step 355 further comprises:

in response to said second peer latency, T2, being greater than said first peer latency, T1, performing the following steps:

(520) calculating a first latency ratio, R1(L), for each of said one or more storage devices assigned to said second peer, where R1(L) = AL1(L)/AL2(L);

(525) selecting one of said one or more storage devices assigned to said second peer that has the smallest of said first latency ratio, R1(L), and obtaining an identification number, K, for said selected storage device;

(530) calculating a number of second peer transfers, Nn2(K), for said selected storage device identified by said identification number, K, where Nn2(K) = (T2-Teq-T1)/((1+R1(K))*AL2(K));

(540) in response to said number of second peer transfers, Nn2(K), being greater than said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said selected storage device identified by said identification number, K, to said first peer, recalculate said first peer latency, T1, for said those of said one or more storage devices assigned to said first peer, recalculate said second peer latency, T2, for said those of said one or more storage devices assigned to said second peer and return to step 525; and

(545) in response to said number of second peer transfers, Nn2(K), being less than or equal to said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said number of second peer transfers, Nn2(K), of said selected storage device identified by said identification number, K, to said first peer.

23. The system of claim 17, wherein step 355 further comprises:

in response to said second peer latency, T2, being less than said first peer latency, T1, performing the following steps:

(521) calculating a second latency ratio, R2(L), for each of said one or more storage devices assigned to said first peer, where R2(L) = AL2(L)/AL1(L);

(526) selecting one of said one or more storage devices assigned to said first peer that has the smallest of said latency ratio, R2(L), and obtaining an identification number K for said selected storage device;

(531) calculating a number of first peer transfers, Nn1(K), for said selected storage device identified by said identification number, K, where Nn1(K) = (T1-Teq-T2)/((1+R2(K))*AL1(K));

(541) in response to said number of first peer transfers, Nn1(K), being greater than said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said selected storage device identified by said identification number, K, to said second peer, recalculate said first peer latency, T1, for said those of said one or more storage devices assigned to said first peer, recalculate said second peer latency, T2, for said those of said one or more storage devices assigned to said second peer and return to step 526; and

(546) in response to said first peer transfer number, Nn1(K), being less than or equal to said number of transfers, N(K), for said selected storage device identified by said identification number K, reassign said number of first peer transfers Nn1(K) of said selected storage device identified by said identification number, K, to said second peer.

24. The system of claim 17, further comprising the additional steps of:

measuring a first amount of elapsed time for said transferring all data from said first peer to said one or more storage devices assigned to said first peer;

measuring a second amount of elapsed time for said transferring all data from said second peer to said one or more storage devices assigned to said second peer;

recalculating said first average latency, AL1(L), by use of said first amount of elapsed time with a moving weighted average calculation for each of said one or more storage devices assigned to said first peer; and

recalculating said second average latency, AL2(L), by use of said second amount of elapsed time with said moving weighted average calculation for each of said one or more storage devices assigned to said second peer.